SPECIFICATION

FOR

HEATING AND VENTILATION AND SPECIAL PIPING SYSTEMS

OF

TWO LABORATORY BUILDINGS

FOR THE

UNITED STATES DEPARTMENT OF AGRICULTURE,

WASHINGTON, D. C.

JAMES WILSON, Secretary of Agriculture.

BUILDING COMMITTEE.

B. T. GALLOWAY, Chairman. A. C. TRUE. GIFFORD PINCHOT.

RANKIN, KELLOGG & CRANE, Architects.
JOHN STEPHEN SEWELL, Supervising Engineer.

R. BARNARD TALCOTT, S. FRANKLIN GARDNER,
Mechanical Engineers.

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ADVERTISEMENT.

OFFICE OF THE BUILDING COMMITTEE,
U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., November 24, 1905.

Sealed proposals will be received at this office until 2 o'clock p. m. on the 5th day of January, 1906, and then opened, for the installation of the heating and ventilation and special piping systems of two laboratory buildings for the United States Department of Agriculture, Washington, D. C., in accordance with the drawings and specifications, copies of which may be obtained at the Office of the Building Committee, United States Department of Agriculture.

All applications must be accompanied by a certified check for $100, made payable to the Disbursing Clerk of the Department of Agriculture, which checks will be retained until the return of the drawings and specifications.

B. T. GALLOWAY,
Chairman.

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SPECIFICATION

FOR

Heating and Ventilation and Special Piping Systems of Two Laboratory Buildings for the United States Department of Agriculture, Washington, D. C.

SECTION I.—GENERAL CONDITIONS.

Form of Proposal and Signature.

1. Proposal must be made on the blank form hereto attached, plainly marked "Proposal for Heating and Ventilation and Special Piping Systems," on the envelope or cover, with the title of buildings as given above, and addressed to the Chairman of the Building Committee, United States Department of Agriculture, Washington, D. C., stating in writing and figures (without interlineation, alteration, or erasure) the sum of money for which the bidder proposes to supply the materials and perform the work required by the drawings and specification, the time within which he proposes to complete the work, the separate prices called for in proposal sheet, and also prices of certain parts of the work. The proposal must be signed with the full name and address of the bidder; if a copartnership, the copartnership name by a member of the firm, with names and addresses in full of each member; and if a corporation, by an officer in the corporate name, with the corporate seal attached to each signature. No telegraphic proposals or telegraphic modifications of proposals will be considered. Proposals received after the time advertised for the opening will be returned unopened. If a proposal is sent by registered mail, allowance should be made for the additional time required for such transmission.

Certified Check.

2. Each bidder must submit with his proposal a certified check, in amount $2,000, drawn to the order of the Disbursing Clerk of the Department of Agriculture, and the proceeds of the said check shall become the property of the United States if for any reason whatever the bidder, after the opening of the bids, withdraws from the competition or refuses to execute the contract and bond required, in the event of such contract being awarded to him. Checks submitted by the unsuccessful bidders will be returned after the approval of the contract and bond executed by the successful bidder.

Eight-hour Law.

3. The attention of bidders is called to the Act of Congress, approved August 1, 1892, limiting the hours of daily service of laborers and mechanics employed upon public works of the United States to eight hours in any one calendar day.

Convict Labor.

4. In compliance with Executive order dated May 18, 1905, convict labor can not be employed in connection with this contract.

Subcontractors.

5. No subcontractor or other person furnishing material or labor will be recognized, nor will the United States be responsible in any way for the claims of such persons beyond taking a bond, with good and sufficient sureties, with the additional obligation that the general contractor shall make prompt payment to all persons furnishing him labor or materials used in the prosecution of the work. Persons so furnishing materials or labor to have a right of action on said bond, in the name of the United States for their use.

Designation of Parties.

6. The contracting officer, on the part of the United States, is the Secretary of Agriculture, the officer appointed by him to supervise the construction of the building is designated in these specifications as "Supervising Engineer." The present incumbent of this office is Capt. John Stephen Sewell, Corps of Engineers, U. S. Army.

7. The engineers appointed by the Secretary of Agriculture for the designing and superintending of the mechanical equipment of the buildings are R. Barnard Talcott, consulting mechanical engineer, and S. Franklin Gardner, mechanical engineer and superintendent.

8. All matters pertaining to the installation of the mechanical work are to be handled by the mechanical engineer and superintendent, acting in consultation with the consulting mechanical engineer. All matters, however, involving the structural work of the buildings, modifications in contract, and payments thereon must be approved by the supervising engineer.

9. Wherever the word "bidder" is used herein it shall be held to mean any individual or firm of individuals, or any member of any firm or any corporation signing a bid submitted.

10. Wherever the word "contractor" is used herein it shall be held to mean any individual or firm of individuals, or any corporation, who may contract with the United States to do the work or furnish materials under this specification.

Routine of Business.

11. After the award and signing of the contract, all business relating to the work shall be transacted through the office of the mechanical engineer and superintendent, except as otherwise herein provided.

Rights Reserved.

12. The materials proposed to be used, time for completion of the work, and the competency and responsibility of bidders will receive consideration before award of contract.

13. The Department reserves the right to accept any part or parts of the proposal made at the prices included in same; also to waive any informalities in, and to reject any and all proposals.

Form of Contract.

14. The contract which the bidder agrees to enter into shall be in form based upon the terms of this specification.

Bond.

15. The successful bidder must furnish a bond in a sum equal to 50 per cent of the amount of the contract, with sureties satisfactory to the Department, guaranteeing the fulfillment of all provisions of the contract, the satisfactory completion of the work included therein within the stipulated time, the prompt payment of all persons furnishing materials or labor required in the execution of the work, and covering all guarantees herein provided for.

16. No payment will be made on this contract until the bond has been submitted to the Department and approved by the Secretary of Agriculture.

17. The contractor must obtain, at his expense, all necessary policies of insurance on work and materials supplied by him, as the same will be at his risk until final completion, inspection, and acceptance; but the contractor will be relieved of any risk for such portions of the buildings as may be occupied by the United States before the entire completion of his contract.

Modifications.

18. The Department reserves the right to make any additions to, omissions from, or changes in the work or materials called for by the drawings and specifications, without notice to the surety or sureties on the bond given to secure satisfactory compliance with the terms of the contract; and the United States further reserves the right to demand additional security when additions are made, if in the judgment of the supervising engineer such security is required. For such additions, omissions, or changes, the contractor must submit a

reasonable proposal. If the proposals submitted are deemed unreasonable by the supervising engineer, he shall, acting for the United States, have the right to fix the value of such additions, omissions, or changes, and no claim for damages on account of such changes or for anticipated profits shall be allowed.

Delays.

19. Each bidder must submit his proposal with the distinct understanding that, in case of its acceptance, time for the completion of the work shall be considered as the essence of the contract, and that for the cost of all extra inspection, salaries, and other expenses entailed upon the United States by delay in completing the contract, the United States shall be entitled to a fixed sum of $25 as liquidated damages, computed, estimated, and agreed upon, for each and every day's delay not caused by the United States.

20. *Provided*, That the collection of said sum may, in the discretion of the Secretary of Agriculture, be waived in whole or in part, and that the contractor shall be entitled to one day, in addition to said stipulated time, for each day's delay that may be caused by the United States or may be due to causes which could not have been foreseen or prevented by the contractor.

21. The supervising engineer, acting for the United States, reserves the right to suspend any portion of the work embraced in the contract whenever, in his opinion, it would be inexpedient to carry on said work.

Notice to Sureties.

22. The final inspection and acceptance of the work shown by the drawings and specifications, forming a part of the contract, shall not be binding or conclusive upon the United States if it shall subsequently appear that the contractor has willfully or fraudulently, or through collusion with a representative or official of the United States on the work, supplied inferior materials or workmanship, or has departed from the terms of his contract. In any such case the United States shall have the right, notwithstanding such final acceptance and payment, to cause the work to be properly performed and satisfactory material supplied to such extent as in the opinion of the mechanical engineers may be necessary to finish the work in accordance with the drawings and specifications therefor at the cost and expense of the contractor and the sureties on his bond, and shall have the right to recover against the contractor and his sureties the cost of such work, together with such other damages as the United States may suffer because of the default of the contractor in the premises, the same as though such acceptance and final payment had not been made.

Payments.

23. Payments of 90 per cent of the value of the work executed and satisfactorily in place, based upon the estimated value thereof as ascertained by the supervising engineer, will be made every thirty or sixty days, or as may be provided in the contract, and the payment of the 10 per cent retained will be made after the final approval and acceptance by the supervising engineer of all work and materials embraced in the contract.

24. The supervising engineer, however, shall have the right to suspend payments at any time if in his judgment the contractor is not using due diligence to procure and submit for approval satisfactory samples as required by the contract, and is not prosecuting his work as promptly as conditions of the building demand.

25. To aid the supervising engineer in ascertaining the value of work done and in place, the contractor shall furnish to the said official, before any payment shall be due, a schedule of prices upon which the contract is based.

Supervision.

26. Every part of the work is to be executed under the direction and to the entire satisfaction of the mechanical engineers, and subject to the final approval and acceptance of the supervising engineer.

Measurements.

27. Bidders should visit the buildings in order to get a satisfactory comprehension of the work required and make such measurements as they may desire, as the drawings accompanying this specification are not intended to be scaled.

Time to complete.

28. The contract time for the completion of the two laboratory buildings is June 14, 1907, and the work on these buildings under this contract must be begun as soon, and prosecuted as fast, as the condition of the buildings will permit, under the direction of the mechanical engineers, and at such times as will avoid interference with other contracts, and must be completed by the above date.

Patents.

29. The Department will not recognize any demand brought on account of infringement of patents; but will hold the contractor and his bondsmen strictly responsible for any delay or cost resulting from his failure to fully protect the United States against patent rights.

Tools and Appliances.

30. All tools and appliances required for the proper execution of the work must be provided by the contractor and be maintained, used, stored, and moved at his expense and risk.

Lighting.

31. Contractor must furnish and maintain all artificial lights necessary for the proper execution of the work.

Cutting, Restoration, and Removal of Débris.

32. Contractor shall at his expense do all necessary cutting, drilling, etc., repair in the best possible manner, under the direction of the supervising engineer, any damage to his own or others' work and materials incident to his contract, and remove from the premises all débris resulting from the execution of his contract.

Inspection and Acceptance of Work.

33. Any materials delivered or work performed by the contractor, at any and all times during the progress of the work and prior to its final acceptance and the payments therefor, shall be subject to the inspection of the mechanical engineers, who shall reject any part that in their opinion is not strictly in accordance with the contract.

Tests.

34. After the completion or during the progress of the work the Department shall authorize such tests of the installations to be made as may be considered necessary. If these tests show that the work does not comply with the specification requirements, the contractor must immediately make all changes necessary to put the work in proper condition, and shall pay the expenses of all subsequent tests and inspections required to determine whether or not the work is satisfactory.

35. In case the contractor fails to make, within a reasonable time, such changes as are demanded by the mechanical engineers, the supervising engineer reserves the right to have such changes made at the contractor's expense.

Personal Interview.

36. The right is reserved to require the contractor or his authorized representative to visit the Department, without expense to the United States, if at any time it is considered that, in the interest of the United States, a conference is necessary for the prompt adjustment of any complicated or unsatisfactory conditions that have developed in connection with this contract. Any understanding arrived at as a result of such conference shall not be binding until formally approved.

Interpretation of the Specification.

37. In all questions relating to the interpretation of this specification or any part thereof, the decision of the mechanical engineers, concurred in by the supervising engineer, shall be final.

Foreman, etc.

38. The work shall at all times be conducted in charge of a competent superintendent or foreman, who shall represent the contractor and have general authority to act for him, and the contractor shall discharge and not employ upon this work any foreman or any and all workmen whom the supervising engineer may deem incompetent or careless. The contractor shall also give his personal attention to the work.

Materials and Workmanship.

39. All materials and appliances used under this contract, unless specifically described, shall be of best grade of standard manufacture, and all workmanship shall be strictly first-class.

40. The bidders are required to fill out on the proposal sheet the clauses relating to materials and appliances which they propose to use; also to give the name and address of manufacturers of special appliances required under this contract.

41. Should bidder fail to submit such a list of materials and appliances, or in the event the materials and appliances named on the proposal sheet in any case are considered unsatisfactory, the Department reserves the right to name articles and materials which will conform to the specification, and the selection by the Department shall be final and binding upon the contractor.

Samples.

42. The Department reserves the right to require the contractor to submit samples of any or all articles or materials to be used under this contract, which samples, if approved, may be used on the work after serving their purpose as samples.

43. Samples if requested must be received in ample time for their proper consideration and approval, and for the execution of the work thereafter within the contract time for completion.

44. In the event the contractor delays the submission of samples when called for, so that there does not appear to remain sufficient time for the execution of the work, the Department reserves the right to abrogate the contract or to purchase materials and have the work performed at the expense of the contractor.

Approval of Appliances.

45. The approval of any appliances or materials named or submitted by contractor is to be understood as subject to the specification requirements, and not as an absolute acceptance.

Construction of Buildings.

46. The buildings are to be of solid masonry construction, all walls and partitions being of brick, the outside walls being faced with

stone or face brick, and furred on the inside with 2-inch-thick hollow terra-cotta furring blocks.

47. All interior partitions are of brick, and the double partitions are to be formed with two $4\frac{1}{2}$-inch brick walls having a 14-inch space between.

48. Floor construction is to be of reenforced concrete, composed of reenforced concrete beams separated by terra-cotta tiles.

49. It is contemplated having each floor construction put in as the walls go up, and this contractor will be permitted to rough-in his risers, piping, etc., up to the under side of the highest floor in place, but will not be allowed to place any work entirely exposed to the weather.

SECTION II.—GENERAL DESCRIPTION.

Scope of Work.

50. This specification, with accompanying drawings, is to describe a complete heating and ventilating system, and also a system of special piping for laboratory purposes.

Drawings.

51. The drawings, Nos. H–V–1 to H–V–15, inclusive, show the complete layout of the heating and ventilating system, and drawings Nos. S–P–51 to S–P–58 show the work required in connection with the special piping system. Proposals submitted must be based on these drawings.

Explanation of Drawings and Specifications.

52. The drawings are to be taken together with the specifications and not separately, and should there exist any discrepancies between them the contractor should apply to the mechanical engineers for further and particular instructions for each case, and failing to do so shall make the work right at his own expense, to the satisfaction of the mechanical engineers.

53. The drawings above referred to include plans of both buildings, designated as Laboratory A and Laboratory B. The two buildings are entirely similar in construction except that they are placed in reverse positions, and the systems as laid out to be installed in the two buildings are practically identical. The plans of both buildings are provided for convenience in installing the work.

54. This specification will, however, refer only to the installation in one building, and the bidders must understand that the specification applies to both buildings alike.

SECTION III.—HEATING AND VENTILATING SYSTEM.

System.

55. The building is to be heated by indirect hot-water radiation, except corridors and toilet rooms, which are to be heated by direct hot-water radiation.

56. The air for the indirect heating and ventilating is to be circulated by two centrifugal fans on the supply end of the system and by two disk fans on the exhaust end.

57. In addition to the usual room ventilation, flues are provided from each room for special vents for laboratory hoods. These flues discharge into portions of the attic space from which the air and gases are to be exhausted through the roof by three disk fans.

58. All brick air passages in subbasement, and all hot-air and vent flues shown on the plans, in the cross partitions, are not included in this contract.

59. Hot water at the required temperature is to be supplied from a central plant, the mains under this contract to terminate at the end of the corridor in subbasement as indicated.

Air Supply.

60. Three openings, for air inlets, through the outside walls of the cold-air chambers, with gratings, etc., have been provided under another contract. The cold-air chamber is to be separated by a sheet-metal partition from the fan room, which partition is to have openings into the two sets of tempering coils and air washing apparatus, arranged as shown on plans.

61. The tempering coils and washing apparatus are to be incased, the casings being provided with doors and by-pass dampers as indicated. The supply fans are to discharge the air into the brick plenum chambers, from which the air is forced into the secondary heating chambers, and passing through same is discharged into short horizontal ducts, at the subbasement ceiling, connecting with the flues leading to the various rooms.

Air Exhaust.

62. The vitiated air from the rooms is to be conducted through the terra-cotta flues to vent passages in subbasement, from which the air is exhausted by two disk fans into vent shafts, which discharge the air above the roof.

Air-washing Apparatus.

63. The air-washing apparatus to be installed must have a capacity to wash, in the two chambers, not less than 36,000 cubic feet of air per minute, the temperature of the air being approximately 40° F.,

and to have an efficiency of not less than 98 per cent, to be determined by such tests as the Department may require at the completion of the installation.

64. Bidders are required to state on the proposal sheets the amount to be deducted from the total bid if the entire air-washing apparatus, as specified, is omitted, including piping in spray chambers with nozzles, eliminators, concrete water basins of spray chambers, with water and drain connections, cesspools with drain connections, one centrifugal pump with motor, motor tablet with mountings, and pump discharge and suction connections.

65. Bidders are also requested to state on the proposal sheets an amount for which they will install, complete, an air-washing apparatus different from the system specified but which might be used under the existing conditions. Descriptive drawings and outline specification for any such system must be submitted with the proposal. In the event that this alternate system of air washing be accepted, the contractor must submit detailed working drawings, which must be approved by the mechanical engineers before execution of any work.

66. After the award of the contract the contractor must furnish, for the approval of the mechanical engineers, detailed drawings in triplicate, showing all parts of the air-washing apparatus, including pump connections, nozzles, eliminators, etc., and also a detail specification covering the appliances.

Water for Air Washing.

67. The water supplied for the air-washing system must be ample to accomplish the results herein required, being not less than 2 pounds of water to 1 pound of air.

68. The spray nozzles must be sufficient in number and properly arranged to distribute the water uniformly across the spray chamber, two rows of nozzles, in the direction of the air flow, being used.

69. The water from the nozzles is to be collected in a concrete basin below each spray chamber, from which the circulating pump suction is to be run.

Eliminators.

70. The eliminators are to consist of a series of vertical-bent galvanized-iron plates, set in oblique positions, securely bolted or riveted at the top and bottom to suitable cast-iron clips fastened to galvanized-iron top and bottom plates, which plates are to be secured to casings or to the concrete bases, as the case may be. The bottom plates to be bent at the back and front edges to prevent the water from washing beyond the eliminators and to allow the water to discharge into the tanks below spray chambers. The plates of the eliminators must be so arranged and in sufficient numbers to remove all

the unevaporated moisture from the air and to prevent any water from being carried beyond the eliminators.

71. The eliminators and top and bottom plates are not to be lighter than No. 20 B. W. G. galvanized iron.

Pumps.

72. There are to be furnished and placed where shown, in room adjacent to fan room in subbasement, two single stage centrifugal pumps of a first-class and approved construction, having direct-connected electric motors.

73. Pumps to be duplicates, each arranged to circulate the water for the air-washing apparatus, or for discharging the water from the catch-basin into the 3-inch waste line at subbasement ceiling. The pumps to have a capacity for discharging 175 gallons per minute against a head of 14 feet.

74. The pumps and motors are to be mounted on the same base, and the two pumps are to be placed on one brick foundation of suitable height, selected brick being used on the exposed surfaces of foundation. A 4-inch-thick stone cap is to be provided for same.

75. The pumps are to be cross-connected and valved on both suction and discharge connections, and the connections run as indicated on the plans. A brass swinging check valve is to be placed on the pump discharge connecting with the 3-inch waste line at subbasement ceiling.

76. A ¾-inch priming pipe is to be connected to the suction of each pump, near pump, the water connection to run from outlet in fan room. A pet cock is to be placed at highest point in each pump casing.

77. Bidders must state on proposal sheet the make, size, and speed of the pumps and motors proposed to be furnished.

Catch-basin.

78. Where indicated in pump room, a 36-inch-diameter by 54-inch-deep heavy-pattern cast-iron catch-basin is to be placed, set so that the top will be about 8 inches above the floor line. The top or cover of the catch-basin is to be securely bolted to basin, and a small removable cover plate, about 12 inches diameter, having a lifting ring, is to be provided in top, the top being recessed to receive this cover plate. Provision is to be made in basin for one 3-inch-diameter and one 4-inch-diameter drain connection, the centers of these inlets to be approximately 24 inches below the top of cover. The pump suction at basin is to start near bottom, where an approved foot valve with strainer is to be placed. This connection to pass through side of basin above the floor line. A small opening for a chain connecting with a ball float in basin is also to be provided through cover.

Drain Connections, etc.

79. Three extra-heavy, cast-iron, bell-trap cesspools with 3-inch side outlets and hinged covers are to be provided and placed in heater room where indicated.

80. A 3-inch overflow and also a $1\frac{1}{2}$-inch valved drain connection is to be provided for each water tank of spray chambers, which connections are to be connected with the drain from the cesspools and run to the catch basin in pump room as indicated.

81. The valves on the drain connections and also on the pump suction connections from tanks are to be placed in concrete boxes properly formed and lined with $\frac{1}{2}$-inch-thick cement mortar. Covers of $\frac{1}{2}$-inch-thick cast iron, with holes through same for valve stems, are to be provided for the valve boxes. The top of covers to be set flush with finished floor line.

82. At the point where noted in pump room, a 3-inch-diameter connection is to be made to the drain from cesspools in place in corridor and connection run to catch-basin.

83. Where indicated in cold-air chamber, a 4-inch-diameter connection is to be made to drain in place, and connection run to catch-basin.

84. The suction pipes of pumps, from the tanks in spray chambers, are to be run below floor to the pumps, as indicated.

85. All drainpipes must be properly graded to drain to catch-basin.

86. A $1\frac{1}{4}$-inch-diameter connection provided with a globe valve and also an approved automatic float valve with 5-inch-diameter copper ball float is to be made to each water basin of spray chambers as indicated, the water supply to be taken from an outlet in heater room.

Centrifugal Fans.

87. For the air supply of each building, contractor must furnish and install two full-housed steel-plate fans, having double inlets and top horizontal discharge. Fans to be driven by electric motors by silent chain belts of first-class and approved manufacture.

88. Wheels of fans must be well balanced and designed for noiseless running, mounted on and well secured to shafts, each shaft running in two bearings, having self-lubricating journals. Sprocket wheels must be overhung but kept as close to housings as possible.

89. Fans to be set slightly below the floor level, as indicated by details, the bottoms of the metal housings forming linings for the recesses in concrete foundations.

90. Housings with largest diameter, approximately 140 inches, are to be constructed of heavy steel plate well stiffened with angle or tee bar braces, the braces being secured to base angles which are

to be firmly bolted to the concrete foundations. The housing of one of the fans is to be fitted closely to the brick air duct, as indicated.

91. The fan wheels are to be approximately 84 inches diameter and each fan must have necessary capacity to discharge 18,000 cubic feet of air per minute against a maintained pressure of $\frac{1}{4}$ ounce per square inch, the fan having a peripheral velocity of approximately 3,000 feet per minute, under which conditions the motor must be operating at approximately the guaranteed full load.

92. If the tests develop that it requires 15 per cent more power than guaranteed, or that the motor is not operating under test conditions within 2 per cent of the full-load efficiency guaranteed; or that it requires more than 15 per cent increase in the specified peripheral speed of fan wheel to maintain the $\frac{1}{4}$ ounce per square inch pressure specified, while delivering the required volume of air per minute; or, if under test conditions the fan delivers 15 per cent in excess or 10 per cent less than the 18,000 cubic feet of air specified, the fan, or motor, or both, as the case may be, will be rejected, and the contractor will be required to furnish an outfit which will meet the specification requirements.

93. Each bidder must state on the proposal sheets the name of manufacturer of the fans, and must also give the diameter and width in feet and inches of the fan wheels, the number of revolutions per minute, diameter of inlets, and dimensions of outlets.

94. After the fans with motors are assembled at the building in complete working order, one of the fans, as directed by the mechanical engineers, is to be tested to see if the motor and fan comply with the specification requirements. The cost of the test must be borne by the contractor, who must furnish all facilities for the test, the Department furnishing the necessary instruments for the determination of the results.

95. For the test, all outlets from one of the pressure chambers are to be sealed up air-tight with double thickness of $\frac{7}{8}$-inch boards with tar paper between, or in any other approved manner. The outlet for the discharge of the air is to be square, to be made of galvanized iron, to have an area equal to twice the area of the fan outlet, and to be in length equal to three and one-half times the dimension of one of the sides. The outlet nozzle must be fitted with louvre dampers or register valves, placed at the junction of the outlet nozzle with chamber, the dampers being arranged to be operated from outside the chamber. Necessary openings must be provided in chamber for the purpose of obtaining readings of the pressure within the chamber, which openings are to be protected from the impact of direct air currents. The volume of air discharged will be measured by an impact gauge or an anemometer at the end of the discharge nozzle,

or by an anemometer at the fan inlets, or both, and during the test the pressure specified must be maintained within the pressure chamber.

Disk Fans.

96. For the exhausting of the vitiated air in the rooms and the gases of the laboratory hoods, disk exhaust fans of all metal construction, designed to work against pressures, and of first-class and approved make, are to be installed.

97. The fans for exhausting the air from the rooms are to be placed in subbasement, one at each of the two vent shafts, one fan to be 60 inches diameter, to run at a speed of 320 revolutions per minute, and the other fan 48 inches diameter, to run at a speed of 330 revolutions per minute.

98. The fans for exhausting the hood gases are to be located at the three vent shafts in attic, two of the fans to be 54 inches diameter, to run at a speed of 290 revolutions per minute, and the other fan 48 inches diameter, to run at a speed of 330 revolutions per minute.

99. All fans are to be driven by direct-connected motors, the motors for fans in subbasement being supported from the fan frames and the motors of attic fans being placed on the fan shafts extended. The motor for the 60-inch-diameter fan in subbasement may, if desired, be placed on a separate foundation. The shafts of the attic fans are to be extended through the exhaust chambers, having one bearing attached to fan frame and one on motor foundation in corridor. Motors to be mounted on piers in corridors, the piers to be of brick with stone caps or of sheet-metal construction, strongly framed with angle irons and firmly secured in place. Openings through the corridor walls, for the shaft extensions, are to be provided with tight-fitting sleeves properly placed and openings between sleeves and shafts are to be closed practically air-tight, in an approved manner.

100. Fans are to be secured, at the inlets to the vent shafts, to wood frames constructed of 4 by 6 inch dressed yellow-pine stock, securely braced and bolted in place. Fans in subbasement may be supported on special iron bases if desired, in lieu of the wood frames.

101. The space between fan frames and sides of openings are to be tightly closed in with No. 16 B. W. G. sheet iron, bolted to the metal fan frame and secured at edges of openings to a 2-inch angle-iron frame running entirely around the edges of the opening, secured in place by expansion bolts. Strips of rubber packing are to be placed at the joints of sheet metal to fan frames and also at the edges of the shaft openings to make absolutely tight joints.

102. Fan blades, blade braces, etc., of the attic fans are to be securely bolted in place and not riveted.

103. All parts of the attic fans and the sheet-metal and angle-iron work connection therewith are to be double-galvanized; finish of other fans to be as hereinafter specified.

104. Bidders must state on the proposal sheets the name of manufacturer of the fans, and must also give a guaranteed capacity, under free discharge, for each fan of the diameters given, when running at the speeds specified. If required by the mechanical engineers, shop tests of the fans must be made, at the contractor's expense, to determine their capacity under free discharge when running at the speeds specified. Tests, if made, are to be run as directed by the mechanical engineers.

Motors.

105. All motors required under this contract for pumps and fans are to be of approved manufacture, designed for 220 volts, direct current.

106. Motors for pumps and attic fans to be attached to pump or fan shafts by insulated and flexible flange couplings of approved construction, allowing an independent alignment of motor and pump or fan shafts.

107. The motors for pumps and air-supply fans must be of ample capacity to comply with the requirements as herein specified for pumps and fans.

108. The motors of the exhaust disk fans are to be of the following brake horsepower capacity when running at maximum efficiency:

For 60-inch-diameter fan, 3.5 H. P.
For 54-inch-diameter fans, 2.0 H. P.
For 48-inch-diameter fans, 1.5 H. P.

109. Motors must be designed to be capable of speed control, by shunt field resistance only, from full-load speed, as herein specified, to half full-load speed and intermediate speeds. At the lower speeds the motors must run within the same conditions of heating limits and sparkless operation as are specified for the higher speeds. All motors must be capable of carrying their full loads for a period of two hours' continuous run, at the expiration of which time the heating effect upon the armature or field must not exceed 80°F., and upon the commutator 90° F., above the temperature of the surrounding atmosphere.

110. Commutation must be practically sparkless at all conditions of speed and load within the limits specified.

111. Armatures must be of tooth core construction, with coils wound in mica-lined slots, the windings thoroughly insulated and firmly secured in place. Armatures must be well balanced both electrically and mechanically, well ventilated, and easily removable.

112. Field spools are to be removable.

113. Commutators must be of drop-forged or hard-drawn copper of highest conductivity, insulated with mica of even thickness, and having ample bearing surfaces for brushes and provision for wear.

114. Brushes to be of carbon, mounted on common rocker arms, and to have a cross-sectional area of not less than 1 square inch for each 35 amperes of current.

115. Brush holders are to be constructed in a manner to permit all necessary adjustments to be conveniently made, and designed to prevent chattering of brushes.

116. Frames of motors to have an insulation resistance from field coils, armature windings, and brushes of not less than 1 megohm. Motors must be capable of standing a break-down test of not less than 1,000 volts, alternating current, for one minute.

117. The horsepower, efficiencies, heating effect, insulation resistance, etc., of the motors must be determined by actual tests made at the shops where motors are constructed, in the presence of the Department's authorized agent, who shall determine the test conditions.

118. Bidders must state on the proposal sheets the guaranteed efficiencies of each motor at half, three-quarters, and full load and give the speed and guaranteed horsepower of the centrifugal fan motors, under test conditions, and that of the pump motors, under conditions specified.

Motor Tablets, etc.

119. All fan motors and one pump motor are to be provided with approved make combination starting and regulating rheostats with underload and overload release, the regulation to be as herein specified, and also a 25-ampere, 220-volt, D. P., S. B. knife switch with inclosed fuses. Two sets of fuses are to be furnished with each tablet.

120. The rheostat for one of the pump motors is to be an approved-make automatic-starting rheostat with overload and underload release, designed to be operated by a ball float to be placed in the catch-basin herein specified. All necessary chain, pulleys, weights, and a 5-inch-diameter copper ball float are to be furnished and properly connected under this contract.

121. The switches, fuses, rheostats, etc., for the two pumps are to be mounted on the same tablet, and necessary switches must be provided and connections made so that the leads from either set of starting or controlling apparatus can be connected to either motor, as desired.

122. The apparatus for the two air-supply fan motors is to be arranged on one tablet.

123. Tablets are to be of polished blue Vermont marble, not less than 1¼ inches thick, with beveled edges and of ample size for the proper arrangement of the rheostats, switches, fuses, etc., as called for above.

124. Tablets to be secured to walls at points designated by the mechanical engineers, approximately where indicated on the plans, being placed far enough from walls to allow easy access to all connections. All connections to be made at rear of tablets, connections between copper lugs and wiring to be soldered, and between lugs and bars to be bolted. Wiring from junction boxes, provided under another contract and located adjacent to the locations shown on plans for motor tablets, and from tablets to motors, to be best quality of double-braided, rubber-covered wire, run in standard iron conduit in an approved manner, all conduits being securely fastened in place.

125. After the award of the contract, the contractor must submit in triplicate, for the approval of the mechanical engineers, complete detailed drawings of all motor tablets, showing size of slabs, arrangement of rheostats, switches, fuses, etc. Tablets are not to be constructed until drawings of same have been approved.

Sheet-iron Work.

126. The casings of the two sets of tempering coils and air-washing apparatus, the partition between cold-air chamber and fan and heater room, the partition between fan room and pressure chamber, the tempered-air flue in corner of fan room and the metal ceiling in vent shaft are to be constructed of ⅛-inch-thick wrought-iron or mild-steel plates, framed as indicated in all cases with 2-inch angle irons, bolted together. Strips of rubber packing are to be placed at all joints to make same air-tight.

127. The sides of the casings for the tempering coils and air-cleaning apparatus are to be divided into sections or panels as indicated, the plates being bolted to angles on all sides. These panels are to be bolted together at the sides, bolted to an angle at the top, and secured to floor by expansion bolts.

128. A panel is to be placed below the coils at the cold-air inlet end of each of the casings and above these panels large double doors covering full area of the heater surfaces are to be provided.

129. The openings from cold-air chamber between the tempering coils, between the tempering coils and wall of pump room, and the space above the tempering coils are to be closed, as indicated by the details.

130. All openings in metal casings for doors or dampers are to be reenforced with 2 by ¼ inch bar-iron strips securely riveted in place, reenforcing bars at back edges of doors to project slightly beyond edges of openings in casings to form a recess for the doors.

131. Doors shown in the metal partitions are to be ⅛ inch thick, of material of partitions, reenforced at the edges with 2 by ¼ inch bar iron and all necessary crossbars to make doors rigid. Reenforcing strips at the front, top, and bottom of doors are to project slightly beyond the edges of the doors in order to lap over the edges of the openings when doors are closed. Doors are to fit openings tightly, to be hung on heavy-pattern hinges and provided with suitable catches, two for each door, designed to draw doors tightly closed when latch is forced in place. Suitable catches are to be provided on the large double doors at the cold-air inlets to tempering coils, to fasten same when half open or wide open.

132. The partition between fan room and pressure chamber is to be framed around the fan discharge outlets and the tempered-air inlet as indicated.

133. The metal flue connecting the pressure chamber with the brick duct in fan room is to be framed as shown.

134. The vent shaft in tempered-air passage where indicated is to be closed by a metal ceiling placed on line with or slightly above the adjacent subbasement ceiling line, the ceiling, as specified, to be of ¼-inch-thick iron secured on all sides with 2-inch angles bolted in place. Ceiling to be provided with a tight-fitting trap door about 18 by 24 inches in size to allow access to ladder of shaft. Trap door to be reenforced, as specified for other metal doors, and to be provided with suitable hinges and catches. Openings must be provided in this ceiling for certain waste and water pipes to pass through same.

135. All holes for pipes in plates must be accurately located and neatly cut, fitting closely around pipes.

By-pass Damper.

136. A by-pass damper is to be provided in the casing of the tempering coils and air-washing apparatus just beyond the eliminators. Dampers to be 2 feet 3 inches wide by 7 feet high, of ⅛-inch sheet iron reenforced with 2 by ¼ inch bar iron, made to fit openings closely, and arranged to close against suitable stops. Dampers to be supported in an approved manner on roller or ball bearings, or with steel pivot working in brass-lined bearings.

137. Dampers must be arranged for thermostatic valve control, as hereinafter specified.

Galvanized-iron Work.

138. The connections from the indirect chamber in the subbasement to the vertical hot-air flues, including the cold-air by-pass connections, are to be installed under this contract, and are to be constructed of No. 24 B. W. G. galvanized iron, of sizes given, and run

as indicated by the plans and details. The pipe shafts A, B, C, D, E, and F of the special piping system (see drawing No. S–P–51) are to be closed on a line with the subbasement ceiling, in an approved manner, with No. 20 B. W. G. galvanized iron properly secured in place and fitting tightly around pipes.

139. All vertical flues are included in a previous contract and are provided at subbasement ceiling with inlet elbows, having dimensions given on plans for vertical flues, with edges arranged for slide joint connections.

140. Bends in ducts are to be made with long smooth curves and 90 or 45 degree elbows as indicated. Offsets in ducts to be made at bottom close to connections to flues. Joints in galvanized-iron work, unless otherwise specified, to be slide joints constructed as shown by details on drawing No. H–V–1.

141. The large ducts, shown on drawing No. H–V–1, in fan and pump rooms and in tempered-air chamber, connecting the terra cotta vent flues with the vent passages, are to be constructed of No 22 B. W. G. galvanized iron framed with 1¼-inch galvanized angles and provided with all necessary stiffening angles across top, etc., to make the construction rigid. Connection to base of flues and to air passages are to be made air-tight in an approved manner.

142. All ducts are to be properly and securely supported from ceilings by bar-iron straps bolted to ceilings.

Volume Dampers.

143. In each duct connecting with the heat flues a volume damper is to be installed, placed near connection to flue, unless otherwise indicated.

144. Dampers are to be of swinging pattern, fitting duct closely, and to be of material of duct, made in a substantial manner and provided with suitable malleable-iron fittings. The operating mechanism of dampers is to be attached to bottom of ducts and must provide an approved means for securing the dampers in any desired positions. The device must be of good construction and made of malleable iron.

145. In lieu of the swinging dampers, volume dampers of design indicated by detail on drawing No. H–V–1 may be used, dampers and fittings to be of materials required for swinging dampers.

Mixing Dampers.

146. Mixing dampers are to be provided at each duct connecting with the indirect stacks, dampers to be located as shown by details on drawing No. H–V–8.

147. The mixing dampers must be properly connected so as to be operated together and arranged for thermostatic control, as hereinafter specified. The dampers are to be constructed of No. 24 B. W. G.

galvanized iron, made to fit the ducts closely and provided with suitable bearings so that the same will operate easily. The operation and controlling arrangements of these mixing dampers must be satisfactory to the manufacturers of the automatic temperature-control system approved for this work.

Registers.

148. Registers are to be provided and set under this contract at all air-supply inlets, vent outlets, and toilet-room vents, indicated on the plans by H–A, R–V, and T–V, respectively, a top and also a bottom register being provided on each vent flue, including toilet-room vent flues. Also, one 8 by 12 inch register is to be placed in each janitor's closet near ceiling, connecting with an inverted hood placed under another contract. Registers are not to be provided at hood vent inlets marked H–V on plans.

149. Register boxes, with cleats for supporting registers, are not included in this contract, but are to be placed under another contract.

150. Registers are to be of sizes given on plans or herein specified, to be of cast iron or sheet steel, of plain latticed pattern with black japanned finish and of first-class and approved manufacture.

151. Top registers, including registers in janitor's closets, are to be provided with brass chains and metal indicating handles for operating valves.

Covers for Hood Vent Inlets.

152. At each hood vent inlet, indicated on the plans as H–V, a wood cover with frame is to be provided and securely fastened in place. Covers and frames are to be constructed of quartered white oak in accordance with details on drawing No. H–V–2 and finished with three coats of paint to match finish of adjacent woodwork.

153. Each cover to be provided with two brass handles, finished and lacquered.

154. The different parts of the covers and frames are to be properly framed and fastened together with screws, in a workmanlike manner.

Temperature Control.

155. Each of the mixing dampers in the individual hot-air ducts are to be controlled by diaphragm valves operated by thermostats in the different rooms. One thermostat is to be placed in each room, located as directed by the mechanical engineers, which theromstat is to operate the diaphragm valves of the mixing dampers of the two ducts through which the heated air is discharged to the room, in the case where the room has two hot-air inlets, and the one mixing damper where but one air inlet is provided.

156. The by-pass or mixing dampers, hereinbefore specified, in the casings of air inlets to fan room from cold-air chamber, and also valves on the flow connections to each section of the tempering coils, on both sides of the spray chambers, are to be controlled by diaphragm valves, operated by thermostats.

157. A thermostat is to be placed in the spray chambers just beyond the first three sections of tempering coils, which thermostat is to regulate the diaphragm valves on these three sections of coils, shutting off one after the other when the temperature in the spray chamber exceeds a fixed temperature between 40° and 50° F., the three coils being shut off when the air in the cold-air chamber reaches the fixed temperature. A thermostat is also to be placed in the fan room to regulate the diaphragm valves of the mixing or by-pass damper and the last three sections of the heating coils, so arranged that as the temperature of the air in the fan room exceeds 70° F. the mixing damper will be gradually opened, until wide open, and then the three sections of the heating coils will be cut off, one at a time, until, when the air in the chamber just beyond the eliminators reaches 70° F., the damper will be wide open and the last three sections of the coils shut off.

158. The above arrangement of thermostats, dampers, and valves is tentative and consideration will be given to a modification thereof under a guarantee that the desired results will be accomplished by the modified arrangement.

159. The damper and valves of tempering coils of the two air inlets from cold-air chamber are to be controlled entirely separate.

160. The details showing connections to the tempering coils are arranged for hand-control valves only, but necessary modifications in the connections will be allowed to accommodate the thermostatic valves, the hand-control valves to be installed in any case.

161. Thermostats controlling dampers must operate so as to provide for a graduated movement of such dampers, and thermostats controlling valves on the connections to the tempering coils must operate positively or with graduated motion.

162. The diaphragm valves for mixing dampers, etc., are to be placed in most advantageous positions as directed by the mechanical engineers, to allow easy access to same.

163. The thermostats and diaphragm valves must be of first-class and approved manufacture, constructed in the most workmanlike manner, all working parts being of metal, except diaphragms.

164. Cases and thermostats are to be of design and finish as approved by the mechanical engineers.

165. From an outlet in the compressed-air main, specified under special piping section of this specification, a connection is to be run to a galvanized-iron air-storage tank which is to be furnished under

this contract; tank to be of ample capacity to care for the entire air supply required for the temperature-control system.

166. The air tank is to be located where directed by the mechanical engineers and to be air-tight under 50 pounds pressure per square inch.

167. In the connection from the compressed-air main, a finished brass reducing valve of approved make is to be placed, to maintain a uniform pressure in the air piping system and an approved accurate pressure gauge is to be attached to the air tank.

168. The air piping to be used in connection with the system shall be either iron or steel pipe thoroughly galvanized inside and outside, fitted with malleable-iron fittings, except where pipes are to be concealed in walls, etc., where a composition pipe of lead and tin properly armored may be used. All runs of pipe must be suitably proportioned and of sufficient size to furnish an ample supply of air for the entire system.

169. From the storage tank four valved air circuits are to be run, one to apparatus in the wing, one to the apparatus in the fan and heater room, one to apparatus in the front half of the main portion of the building, and one to the apparatus in the rear half of the main portion of the building. Risers, where practicable, are to be run in the pipe shafts provided for the risers of the special piping system.

170. All pipes are to be run, tested, and secured in place as directed by the mechanical engineers.

171. Bidders must state on the proposal sheets the system which they propose to use and also the amount included in this proposal for the temperature-control apparatus complete.

Radiation.

172. The amount of radiating surface required for each radiator is given on the plans, and the actual amount furnished must be substantially the same, in no case less. Radiators can only be used on the basis of the actual heating surface in each tube, section, or loop, which rating will be given by the mechanical engineers.

173. All connections of wrought or cast iron radiators, of pipes or loops, etc., to bases, or between the different sections, as the case may be, must be first-class joints, iron into iron, made without the use of any packing or washers.

Direct Radiators.

174. The direct radiators, shown on the plans in corridors and toilet rooms, are to be of cast iron, hot-water type, and of heights and number of columns called for by the plans.

175. Radiators are to be placed as close to the walls as possible, and those in front of windows must not project above the sills of same.

Indirect Radiators.

176. The heating coils, at each of the two air inlets from the cold-air chamber, to consist of three sections on each side of the air washing apparatus, arranged as shown by details on drawing No. H–V–8.

177. Each section is to be constructed of 1-inch, standard-weight, wrought-iron or mild-steel pipe, four pipes deep, the pipes being connected into two special cast-iron headers, one of the headers forming the base of section.

178. The dimensions of the sections and construction of the headers are to be as shown by details on drawing No. H–V–2.

179. The sections are to be supported on brick piers, as indicated, and inclosed by metal casings as hereinbefore specified.

180. The radiators for the secondary heaters, which are to be inclosed in brick chambers as shown by plans and by details on drawing No. H–V–8, are to be cast-iron hot-water radiator sections containing approximately 15 square feet of surface per section. Sections to be approximately 9¼ inches deep by 37 inches long, having extended ring surface with flow and return headers and connections at the same end. Sections to be connected with extra-heavy screw nipples with hexagonal nuts in center, the sections being spaced so that there will be approximately 50 square inches of clear air space between the different sections.

181. For all stacks, except the two in fan room, the sections are to be installed in two banks, one resting upon the other, the stacks being supported on suitable tee bars built into the brick walls of chambers below the lower sections. Suitable iron blocks or supports are to be placed between the banks of sections, at the ends opposite the connections, to allow the sections to be properly graded.

182. The two indirect stacks in fan room are to be arranged as shown by the details, space being provided between the two banks of sections for connections, each bank of sections being separately supported by tee bars as indicated.

Piping.

183. All piping shown on the drawings, and called for in the specification, must be installed in the most workmanlike manner.

184. Pipes must be of sizes noted on plans, or herein specified, run at the elevations given, having sufficient grade to insure proper circulation and draining at the points indicated.

185. Risers supplying the direct radiators are to be run in chases or vent shafts, where indicated.

186. Radiator connections for the direct radiators are to be run in floor construction in every case, proper provision being made for the expansion and contraction of the risers.

187. Semicircular galvanized-iron covers of No. 24 B. W. G. iron, flanged at the bottom edges to rest on the reenforced floor construction, are to be placed over all radiator connections, to prevent the floor filling from packing in around pipes and to allow space for expansion.

188. Valves must be placed on all heating mains, branches, riser connections, etc., on drain and drip connections, and wherever required to give control of the apparatus, in accordance with the intent and meaning of this specification.

189. At points indicated on the plans and details as drips, $\frac{3}{4}$-inch drain connections are to be provided, having globe valves with hose nipples or $\frac{3}{4}$-inch hose valves.

Pipe.

190. All pipe required in connection with the heating apparatus, unless otherwise specified, to be wrought-iron or mild-steel pipe, straight, true, and round. Pipe $1\frac{1}{4}$ inches diameter and under to be butt-welded and proved to a hydrostatic pressure of 300 pounds per square inch; pipes $1\frac{1}{2}$ inches diameter and over to be lap-welded and proved to a hydrostatic pressure of 500 pounds per square inch.

191. Pipes below floors in heater and pump rooms are to be extra-heavy galvanized pipe; cold-water pipe connections to tanks in spray chambers and to pumps, and pump discharge and suction connections above floor to be standard-weight galvanized pipe; all other piping to be standard-weight black pipe.

192. The bent pipe, to be installed where indicated on the plans, must be properly bent without kinks or flat surfaces.

Fittings and Joints.

193. All fittings, except ground-joint unions and couplings, are to be manufactured of best quality tough gray cast iron, the castings to be of uniform thickness, entirely free from sand holes, and to have fine smooth surfaces.

194. Fittings on extra-heavy pipe herein specified to be extra heavy, and on galvanized-iron pipe to be galvanized.

195. Fittings on flow and return mains in corridors of subbasement and on flow and return connections, as indicated, to the tempering coils are to be long-radius flanged fittings; all other fittings to be screw fittings with heavy beads and full-cut tapering threads; fittings on mains 3 inches diameter and larger to be long-radius fittings.

196. All threads on piping must be full and clean cut, and in screwing up the piping no other lubricant other than best linseed oil

and plumbago shall be used; calking of threads on any piping will not be permitted.

197. At flanged joints the pipes must be screwed through the flanges in all cases.

198. All gaskets used must be first-class sheet steam packing of thickness to suit the various sizes of pipes, and cut so as to extend from the inside of pipe bore to outside of flanges.

199. All bolts used must be best wrought iron of the standard number and diameter for the various sizes of flanges. Bolt heads and nuts must be hexagonal and the bolts of sufficient length to project through the nuts not less than $\frac{1}{4}$ inch.

200. Joints in pipe lines having flanged fittings must be made with flanged unions, and flanged connections to valves are to be provided.

Expansion Joints.

201. Two expansion joints are to be provided and placed, one on the flow main and one on the return main, at points indicated on subbasement plan.

202. Expansion joints are to be of seamless-drawn corrugated copper tubing with interior and exterior rings, fitting loosely the corrugations, and having a brass slip tube and cast-iron flanged heads.

203. Joints must be of sufficient length to accommodate the expansion and contraction of the mains, the maximum temperature of the water in mains being 200° F., must be properly supported in place, and be absolutely tight under working conditions.

Supports for Piping.

204. The main pipes in corridors of subbasement are to be supported from 4-inch, 8.5-pound **I** beams, extending across the corridors, placed approximately 10 feet apart, as indicated on drawing No. H–V–1, and as shown by section on drawing No. S–P–51.

205. The beams are to be set at the required elevation into pockets which have been left in the walls, and the spaces around ends of beams are to be properly closed with brickwork and cement mortar.

206. A 4-inch channel-iron support is to be placed where indicated on plan, securely fastened in place with expansion bolts.

207. All pipes are to be supported by approved adjustable pipe hangers, connected by beam clamps to the **I**-beam supports or secured from ceiling by bolts extending through basement floor construction, the bolt heads resting on suitable cast or wrought iron plates.

208. Pipes running along walls are to be supported on expansion rolls held by wrought-iron brackets, secured to walls with heavy expansion bolts.

209. Return pipes running near floors are to rest on pipe rolls supported by cast or wrought iron chairs bedded in place on brick piers,

which are to have suitable dimensions and be built to the proper heights.

210. All pipe supports to be placed approximately 10 feet apart.

211. Where indicated on drawing No. H–V–1 at two points on the flow and return mains in corridor, the mains are to be anchored firmly in place, in an approved manner, by bar-iron straps bolted to the supporting I beams.

Pipe Sleeves.

212. Where pipes pass through brick walls, wrought-iron pipe sleeves, generally two sizes larger than pipe passing through same, are to be placed and the walls are to be properly finished around sleeves, using brick and cement mortar.

213. Where indicated on the subbasement plan, drawing No. H–V–1, pipe sleeves have been installed and are to be used in connection with this work.

Floor Plates.

214. Where pipes pass through floors for radiator connections, they are to be fitted with heavy-pattern cast-iron nickel-plated floor plates with collars.

Valves.

215. All valves $2\frac{1}{2}$ inches diameter and over must be flanged, having iron bodies with brass mountings, and those 4 inches diameter and over to have outside yokes; valves 2 inches diameter and under, unless otherwise indicated, to be threaded and made of best steam metal.

216. All valves must be constructed so that they can be packed under pressure.

217. Each bidder must state in his proposal the make of valves he proposes to use, and each valve furnished must have the name or trade-mark of the maker stamped or cast thereon.

218. Samples of the valves proposed to be used must be submitted to the mechanical engineers for approval, and no valves are to be placed until same have been approved.

Gate Valves.

219. All valves connected with the heating apparatus, unless otherwise specified, are to be gate valves of first-class and approved manufacture, provided with double noncorrosive seats.

220. Valves on all flow and return connections to secondary indirect heaters in subbasement and on riser flow and return connections are to be provided with brass ground-joint unions.

Globe Valves.

221. Where herein specified for drains, drips, etc., and on the air piping of the temperature control apparatus, approved-make globe valves with removable elastic disks are to be placed.

222. On the drip or draw-off connections hose valves may be used in lieu of globe valves with hose nipples.

Radiator Valves.

223. All radiator valves for direct radiators must be angle, steam pattern, brass, nickel-plated all over, of first-class and approved construction, having removable elastic disks and wood wheels with union connections. Valves to be provided on both flow and return connections of all radiators.

Air Valves.

224. On each direct radiator, and where indicated or necessary on the piping in the subbasement, approved-make key, brass, nickel-plated air cocks are to be provided.

Thermometers.

225. On the flow and return connections to the mains of each of the four loops of the hot-water piping system, on the return connections to the mains of the branches supplying the risers and on the return connections from each section of the tempering coils a first-class mercurial thermometer in polished brass frame, with protector for the thermometer tube, is to be placed, set in suitable thermometer cups in fittings.

226. The total number of thermometers, 22 in each building, are to be placed as directed by the mechanical engineers.

Tests.

227. All piping installed in connection with heating apparatus must be subjected to a hydrostatic pressure test of not less than 100 pounds per square inch and made absolutely tight under that pressure.

228. Tests may be made in sections, as directed by the mechanical engineers, and all appliances, including pumps, gauges, temporary connections, etc., necessary for the tests, must be furnished by the contractor.

Pipe Coverings.

229. After the piping has been entirely completed, subjected to the required tests and approved by the mechanical engineers, all the exposed hot-water piping in the subbasement, including flow and return branch connections, etc., are to be covered with nonconducting sectional and removable coverings, not less than 1 inch thick.

Coverings for valves and fittings may be molded of asbestos or magnesia cement, and all coverings must be provided with a heavy canvas jacket.

230. Coverings to be secured in place with solid brass bands, not less than No. 33 B. W. G. in thickness and 1 inch wide.

231. Coverings for pipes in cold-air chambers are to be not less than $1\frac{1}{2}$ inches thick.

232. All coverings must have as a basis either carbonate of magnesia ($MgCO_3$), long-fiber asbestos, or a combination of the two materials; coverings to contain not less than 35 per cent of the basis, the remainder to be made up of carbonate or sulphate of lime. Any other ingredients that may be present in the compound must not aggregate more than 10 per cent of the total compound.

233. A sample of covering must be submitted by the successful bidder immediately after the award of the contract and the mechanical engineers reserve the right to demand and require the contractor to submit other samples if the submitted sample fails to meet the requirements of the specification.

Brickwork.

234. The cross partitions in corridors of subbasement, partition between pump room and cold-air chamber, and other partitions, all to be 9 inches thick, shown by cross-hatching on drawing No. H–V–1, the inclosures for the indirect secondary heaters, foundation piers for motors, pumps, tempering coils, and roll frames of return pipes running near floor, and the walls of the tempered-air duct in fan room are to be of brick and constructed under this contract.

235. All brick to be best quality machine-made red brick, straight, sound, hard-burned, firm in texture, even in size, free from limestone pebbles, laid in a first-class manner, bonded throughout with headers every fifth course, and thoroughly bedded and jointed in cement mortar with close joints flushed full of mortar. All exposed surfaces must be laid with selected brick and all joints must be neatly struck.

236. The mortar for all brickwork to be composed of 1 part by measure of best quality Portland cement to 3 parts by measure of clean sharp sand thoroughly mixed immediately before using.

237. The secondary indirect chambers are to be constructed as indicated by details on drawing No. H–V–8, walls 9 inches thick being built on three sides of the heating surface, the wall of tempered-air passage, constructed under another contract, forming in general the fourth side of the inclosure. The inclosures in pressure chambers and in fan room to be constructed as shown. Openings at the required heights must be arranged for the duct connections, both above and below the heating surface, the brickwork above

the openings being supported on iron-plate lintels, as indicated. The openings for duct connections must be separated by bricks set on edge, the ducts extending to the inside edges of walls. Chambers must be of required sizes to accommodate the radiating surface and also the duct connections. In cases where the walls do not fit closely around the heating surface, the size of the chambers being fixed by the duct connections, the spaces around the radiating surface must be closed air-tight with plates of No. 20 B. W. G. galvanized iron, secured in place by 1½-inch galvanized angles riveted to the plates and bolted to walls and fastened, in an approved manner, with wires at the bottom edge of the indirect surface.

Stone Caps.

238. Stone caps are to be provided on the brick piers for pumps with motors and for the fan-motor piers.

239. The stones are to be of granite 4 inches thick, beveled on top edges and of dimensions to suit the piers, the edges being flush with the sides of the piers. Exposed surfaces of the stones to be 8-cut work.

Concrete.

240. Concrete footings are to be provided for the air-supply fans and their motors, also for the air-cleaning apparatus and tempering coils, as indicated by details on drawing No. H–V–8.

241. The tank in the spray chamber and piers of the air-washing apparatus are to be constructed as shown by the sections.

242. The slab over the tempered-air duct in fan room is to be of concrete, 4 inches thick, reenforced with ¼-inch-diameter steel bars placed 5 inches on centers, the center of the bars being ½ inch up from the bottom of the slab. Centers must be removed and the under surface of the slab coated with cement mortar forming a smooth surface.

243. All exposed concrete surfaces are to be finished smooth and even, with cement mortar; mortar to be applied in an approved manner to assure the adhesion of same to the concrete.

Iron Lintels, etc.

244. Where indicated by the details, channel-bar lintels, or wrought or cast iron plate lintels, are to be provided and placed. All lintels are to be properly bedded in cement mortar and of suitable length to have at least 4-inch bearings at each end.

245. All castings furnished under this contract must be of best quality gray iron, free from defects and having smooth, even surfaces.

246. The clean-out doors, indicated for the secondary indirect heating chambers, are to be furnished and placed under another contract, except the ones for the two heating chambers to be constructed

in the pressure chambers, in which cases the clean-out doors will be furnished by the Government and must be installed by this contractor.

Doors and Frames.

247. Where indicated on the subbasement plan, doors with frames (ten in each building) are to be furnished and placed.

248. Frames to fit 3-foot-wide brick openings, and tops of doors to be 5 feet 6 inches above finished floor line.

249. Brickwork above doors to be supported by 9-inch channel-iron lintels set against tops of frames.

250. Frames to be securely anchored to brickwork, to be not less than 6 inches wide and $1\frac{3}{8}$ inches thick, having rebate strips $\frac{1}{2}$ inch thick securely fastened in place with screws.

251. Doors to be $1\frac{3}{4}$ inches thick, strongly constructed, having horizontal panels.

252. Cast-iron thresholds 4 by 1 inch, with beveled edges, are to be provided and properly secured in place at each door opening.

253. Door openings to be finished with $\frac{7}{8}$ by 3 inch trim on one side and with quarter-round molding on the other.

254. All woodwork to be yellow pine of selected stock and finished with three coats of paint, as directed.

255. Special attention must be given to the fitting of doors and frames, as same must fit practically air-tight.

256. Doors must be furnished with suitable locks, knobs, and hinges, which must be strong and substantial, properly finished, and subject to the approval of the mechanical engineers. All locks to be alike, and six keys are to be furnished.

Cleaning of Apparatus.

257. All parts of the apparatus, including radiators, piping, valves, etc., must be thoroughly cleaned of all iron cuttings, etc., and left in good working order, and contractor will be held responsible for all damage caused by neglect to comply with this provision.

Painting and Bronzing.

258. All ironwork to be painted all over with one coat of best quality red lead and pure linseed oil.

259. Pipes, lintels, etc., covered over or placed underground, to have one additional coat of above paint before being placed in position. All exposed ironwork in subbasement, unless otherwise specified, to have two additional coats. Fans, motors, pumps, casings, etc., to be finished in dark coach color.

260. Galvanized-iron heating and vent ducts in subbasement are to be painted with two coats of metallic paint of selected tints.

261. All the direct radiators, exposed radiator connections, and floor plates are to be bronzed all over with two coats of approved

bronze. Gilt bronze to be used for corridor radiators, and aluminum bronze for radiators in toilet room.

262. Radiators, etc., before being bronzed are to be properly painted with one coat of suitable paint.

263. All canvas-jacketed pipe coverings are to be painted with two coats of best quality asbestos paint, the finishing tints to be selected by the mechanical engineers. Brass bands are to be removed while coverings are being painted and replaced after paint is dry.

SECTION IV.—SPECIAL PIPING SYSTEM.

System.

264. The system of special piping to be installed under this specification and the accompanying drawings is arranged for supplying to each room throughout the building, except toilet rooms, for laboratory use, cold water, hot water, distilled water, compressed air, vacuum, gas, and steam, outlets being provided on mains in all rooms except in fourth story, which rooms are to be supplied from piping in third story.

265. In addition to the piping for laboratory requirements, a system of piping is to be installed for a vacuum cleaning system, for water and waste connections for three drinking fountains in the corridor of each story, and a gas-supply system for connections to combination lighting fixtures in corridors.

Laboratory Piping.

266. The mains of the system of laboratory piping are to be run at subbasement ceiling, starting at the end of the corridor, as shown, with branch connections to risers in the six riser shafts designated as shafts A, B, C, D, E, and F. The risers are to be extended up to approximately the fourth-story floor line, having lateral mains connecting to same near ceiling of each story, the lateral mains having outlets in each room, arranged as indicated on the plans.

267. The outlet fittings in every case are to be crosses, having 1-inch outlets at top and bottom of the mains.

268. In addition to the supply mains a steam drip line is to be run as indicated, and a hot-water circulating main is to be run at subbasement ceiling, with a branch riser in each pipe shaft, which is to be connected to the hot-water supply pipe in the shaft just below the connection to the lateral main at third-story ceiling.

269. The drip from the base of each steam riser is to be collected in a steam trap, the trap discharging into the steam drip line.

Gas Piping for Lighting.

270. Branch connections are to be run from the gas main at subbasement ceiling, at points indicated opposite the three chases in corridor walls, connecting with risers which are to be run up in the chases supplying in each story a lateral main run in floor construction, having branches to the various corridor fixture outlets.

271. The fixture outlets are each to be $\frac{1}{2}$ inch diameter and the nipples for fixture connections must be at right angles to the ceiling from which they project, and must project from finished plaster line

of ceiling not less than $\frac{3}{4}$ inch, nor more than $\frac{1}{4}$ inch, and must be properly capped.

272. The gas piping must be run to form a support for the fixtures and, at the end outlets, piping must be extended about 12 inches beyond the gas nipple connecting with fixture, to form a supporting arm.

Waste Piping.

273. For waste connection from the drinking fountains, hereinafter specified, a waste riser is to be run in each of the three chases, in corridors, as shown on plans. These risers are to run from drinking fountains in fourth story down to subbasement, having $1\frac{1}{4}$-inch-diameter inlets at proper elevations in each story for drinking-fountain connections and to be connected in subbasement to 2-inch plugged inlets, in place just above the subbasement floor line. The chases extend but 18 inches below the subbasement ceiling line and the waste connections must be offset and run down on face of wall with additional offsets near floor around the wall footings, the inlets in place being just outside of the wall footings.

274. Each waste riser must be provided with a 2-inch brass screw-jointed clean-out plug near ceiling of subbasement.

275. The waste connection from the engineer's sink in subbasement corridor, near entrance to fan room, is to be connected to the waste line pump room, which line connects to the catch-basin as specified under Section III of this specification.

Drinking-water Piping.

276. A supply and a circulating main are to be run at subbasement ceiling, connecting where indicated to three sets of risers which are to supply the drinking fountains in each story.

277. The supply risers are to have $\frac{1}{2}$-inch-diameter connections to each drinking-fountain faucet and the circulating risers are to be connected to the supply risers just below the connections from supply risers to the drinking fountains of fourth story.

Vacuum Cleaning System.

278. In each story at the location of the three chases in corridors, just above the baseboards, 1-inch outlets are to be provided for the cleaning system.

279. Risers for the system are to be run in the three chases having connections in subbasement with a main running near ceiling.

280. Each outlet is to be provided with a cap.

281. At each outlet a $\frac{1}{4}$-inch-thick by 4-inch-square cast-brass plate with beveled edges is to be provided, the outlets being through center of plates. Caps of outlets to be screwed up tightly against plates to secure same firmly in position.

282. Caps and wall plates are to be finished brass, nickel-plated all over.

283. All pipe and fittings for this work must be of a make specially adapted for this system. Inner surfaces of pipe and fittings must be absolutely smooth and free from burrs, all fittings to be of long-radius recessed pattern and bent pipe is to be used at all turns where possible.

284. This system of piping must be installed in the most careful manner to secure minimum friction and to avoid all unnecessary fittings and bends.

285. Clean-out plugs are to be installed on all piping to allow cleaning of same.

Connections to Plumbing and Water-supply System.

286. Where indicated in subbasement at the vent shafts, connections are to be made from the mains under this contract at subbasement ceiling to the plumbing water-supply risers; these risers with connections extending out into corridors of subbasement are to be installed under another contract.

287. The connections to be made are as follows: Two 3-inch connections to fire risers, two 3-inch connections to cold-water rising mains, two 1½-inch connections to hot-water risers, two 1-inch connections to hot-water circulating pipes, and two ¾-inch connections to telltale pipes, which latter connections are to be run, as directed at subbasement ceiling, to discharge into engineer's sink.

288. Each of these connections, except to telltale pipes, is to be provided with a gate valve, a drip connection, and a brass ground-joint union.

Piping.

289. All pipes to be run of the sizes given and as indicated on the various plans.

290. Piping to be properly graded to drip connections, and all lateral mains are to be run to drain back to risers.

291. All risers for water piping are to be extended about 3 feet above the highest lateral connections to form air pockets, ends being capped air-tight.

292. Necessary offsets in risers must be installed, made where practicable with 45-degree fittings and nipples.

293. All risers are to be extended up full size from subbasement to highest connections, and all lateral mains are to be of one size from risers to ends of same.

294. Shut-off valves and drip connections are to be provided near the base of all risers, and shut-off valves are to be placed on each lateral main above subbasement, close to its connection to riser.

295. Shut-off valves near the base of the vacuum cleaning risers are to be approved brass stopcocks.

296. All shut-off valves, unless otherwise specified, to be gate valves, and drip connections to consist of $\frac{3}{4}$-inch globe valves with hose nipples, or $\frac{3}{4}$-inch hose valves.

297. The mains at subbasement ceiling are to be grouped as indicated, and all branch connections are to be taken from the tops of the mains; the mains to terminate at the end of corridor as indicated, provided at ends with brass ground-joint unions or union elbows, as the case may be, for future connections from the power house.

298. Plugged outlets are to be left on mains in subbasement where indicated for future connections.

299. Special attention must be given to the arrangement of the various groups of outlets in subbasement and on the lateral mains in the stories above the subbasement.

Pipe.

300. All pipe required in connection with this section of the specification to be wrought-iron or mild-steel pipe, straight, true, and round. Pipe $1\frac{1}{4}$ inches diameter and under to be butt-welded and proved to a hydrostatic pressure of 300 pounds per square inch, and pipes $1\frac{1}{2}$ inches diameter and larger to be lap-welded and proved to a hydrostatic pressure of 500 pounds per square inch.

301. Piping for steam, steam drips, and gas, to be black iron pipe; piping for cold water, hot water, hot-water circulation, compressed air, vacuum, vacuum cleaning system, and wastes to be galvanized pipe; piping for distilled water, drinking water, and drinking-water circulation to be best quality tin-lined galvanized pipe.

302. Bidders must state on the proposal sheet the amount to be added to the total bid if brass tin-lined pipe is used instead of galvanized-iron tin-lined pipe for distilled-water piping only.

Fittings and Joints.

303. All fittings to be manufactured of best quality tough gray cast iron, the castings to be of uniform thickness, entirely free from sand holes, and to have fine, smooth surfaces.

304. All fittings to have heavy beads and screw connections with full-cut tapering threads.

305. Fittings on galvanized pipe to be galvanized, and those on galvanized tin-lined pipe to be special galvanized tin-lined fittings. Fittings on waste piping must be recessed drainage fittings, and fittings of the vacuum cleaning system must be recessed, long-radius fittings.

306. All threads on piping must be full and clean cut, and in screwing up the piping no other lubricant than best linseed oil and

plumbago shall be used, except on gas piping, which is to be put together with red lead or litharge.

307. Special care must be taken with the installation of the tin-lined pipe to make the lining continuous through couplings and fittings, the ends of the pipes at coupling being cut off square and brought together at center of couplings and against shoulder in fittings.

308. Standard cast-iron flanges must be provided on piping for connections to expansion joints and gaskets must be of first-class sheet steam packing of suitable thickness.

Expansion Joints.

309. Two expansion joints are to be provided on each of the steam, steam drip, hot water, and hot-water circulation mains in subbasement, placed where noted on the plan.

310. Expansion joints to be of seamless-drawn corrugated copper tubing with interior and exterior rings, fitting loosely the corrugations, and having a brass slip tube and cast-iron flanges.

311. Joints must be of sufficient lengths to accommodate the expansion and contraction of the mains, the maximum steam pressure being approximately 60 pounds per square inch and the maximum hot-water temperature 200° F. Joints must be properly supported in place and be absolutely tight under working conditions.

Pipe Sleeves.

312. Where pipes pass through brick walls wrought-iron pipe sleeves, generally two sizes larger than pipes passing through same, are to be placed and the walls are to be properly finished around sleeves, brick and cement mortar being used. Two extra 2-inch pipe sleeves are to be provided and set at each point where pipes pass through double partitions and through pipe shaft walls, on line with the other sleeves, one on each side of the group of pipes.

313. Sleeves for pipes passing through double partitions are to extend from outside surfaces of the walls.

314. Where indicated on the subbasement plan, drawing No. S–P–51, and above the door openings in cross partitions of the different stories at the locations of the lateral mains, sections of the walls or partitions have been left out, which will be bricked up under another contract after the pipes with their sleeves have been installed.

Supports of Piping.

315. All pipes in subbasement corridor are to be supported by approved, adjustable pipe hangers, hung by beam clamps from the 4-inch I beams specified to be installed under Section III of this specification.

316. Groups of pipes in subbasement outside of corridors and the lateral mains in stories above the subbasement are to be supported on pieces of 1-inch galvanized-iron tee bars of suitable lengths, suspended by ½-inch bolts passing through the floor construction above, the heads of the bolts resting on ¼ by 4 by 6 inch cast or wrought iron plates; these bolts are to be connected by turn-buckles with other ½-inch bolts having hooks at ends to pass through the upper flange of tee bar, the supports being provided at each end of the tee bars outside of the groups of pipes. The hangers are to be spaced approximately 7 feet apart, one being provided in each case close to riser shafts.

317. Pipes in chases and pipe shafts are to be properly secured in place, in an approved manner, with bar-iron straps or pipe rings.

318. Where indicated at three points on the mains in subbasement, which are specified to be provided with expansion joints, the mains are to be firmly anchored in place by bar-iron straps bolted to the supporting **I** beams.

Wall Plates.

319. Where pipes pass through walls above the subbasement, heavy-pattern cast-iron wall plates are to be provided and be held in place by set screws. Cast-iron plates to match plates around pipes are to be provided and properly secured in place to cover ends of extra sleeves herein specified.

Valves.

320. All valves specified under this section of the specification are to have threaded connections and to be made of best steam metal.

321. Valves must be constructed so that they can be packed under pressure.

322. Valves on tin-lined pipes must be of stop-cock pattern, having inner surfaces heavily tin-coated.

323. Each bidder must state in his proposal the make of valves he proposes to use and each valve furnished must have the name or trade-mark of the maker either stamped or cast thereon.

324. Samples of the valves proposed to be used must be submitted to the mechanical engineers for approval and no valves are to be placed until same have been approved.

Gate Valves.

325. All valves on connections to risers, on lateral mains above subbasement, on connections to plumbing water piping, etc., unless otherwise specified, to be gate valves of first-class and approved manufacture provided with double noncorrosive seats.

326. All gate valves except 3-inch valves on the connections to water piping of plumbing system are to be provided with brass ground-joint unions.

Globe Valves.

327. Where herein specified for drains and drips, approved make of globe valves with removable, elastic disks are to be placed.

Pressure Regulating Valves.

328. Where indicated on the drawings, on each branch connection from the cold-water main at subbasement corridor ceiling, except to the fire risers, a first-class and approved-make brass pressure regulating valve with screw connections is to be placed, to maintain a pressure of approximately 60 pounds on the low-pressure side with 150 pounds presure on the high-pressure side.

Steam Traps.

329. At the base of each pipe shaft, and at the point of reduction in size of the steam main in corridor of subbasement, an approved-make steam trap is to be provided and installed to drip the steam piping.

330. Traps to be supported near ceiling on shelves of suitable dimensions made of $\frac{1}{4}$-inch iron plates bolted to two bar-iron brackets, the brackets being secured to brick walls with expansion bolts.

331. The traps are to discharge into the steam drip lines and a brass swinging check valve is to be placed on steam drip main on riser side of connection from trap.

332. All trap connections are to be provided with globe valves and each trap is to have a valved by-pass connection, in addition to by-pass of traps.

333. Traps are to be located and connections run as directed by the mechanical engineers.

Thermometers.

334. At two points on the hot-water and drinking-water mains in subbasement, first-class mercurial thermometers in polished-brass frames with protector for the thermometer tubes are to be placed, set in suitable thermometer cups in fittings.

335. The thermometers, four in each building, are to be placed where directed by the mechanical engineers.

Engineer's Sink.

336. The sink, in subbasement, to be set and connected where indicated on wall adjacent to fan room, must be of galvanized cast iron 36 by 18 by 6 inches deep, with roll rim.

337. Sink to have galvanized-iron back, securely bolted to wall and provided with air chambers for water connections.

338. The sink to be supported on two galvanized-iron brackets securely fastened to walls with expansion bolts.

339. A strainer and a 2-inch nonsiphoning trap with clean-out plug are to be provided for sink and to be of finished brass.

340. Sink to have $\frac{3}{4}$-inch-diameter, finished-brass, Fuller pattern bibbs on hot and cold water connections and a similar pattern $\frac{1}{2}$-inch-diameter bibb on drinking-water connection. Cold-water faucet to have a $\frac{3}{4}$-inch hose thread.

Drinking Fountains.

341. Fifteen drinking fountains are to be furnished and placed in each building, three being located in each story at position of chases in corridor walls.

342. Drinking fountains to be constructed of solid, vitreous earthenware in one piece, of dimensions and design as given by details on drawing No. S–P–52.

343. Drinking fountains are to be supported in chases by 3-inch Z bars not less than 27 inches long extending across the chases at top and bottom of same, the fountains being held in place by clamps bolted to Z bars and projecting over lugs on fountains. Angles, 1-inch, are also to be placed at sides of fountains secured at ends to the Z bars, all in accordance with details on drawing No. S–P–52.

344. Each drinking fountain is to be provided with a first-class and approved $\frac{3}{8}$-inch self-closing faucet, with connection from piping in chase, and a $1\frac{1}{4}$-inch-diameter waste connection with strainer and half-S trap, connecting with 2-inch waste pipe in chase. Connections to be provided with necessary lock nuts, to secure same firmly in place at fixture.

345. Suitable wall plates with set screws are to be provided at each waste connection.

346. Faucet, waste piping, strainer, trap, wall plates, etc., to be finished brass, nickel-plated.

Gauges and Gauge Board.

347. Where indicated on subbasement plan, a gauge board of $1\frac{1}{4}$-inch-thick blue Vermont marble, highly polished, with beveled edges and rectangular in shape, of suitable dimensions for the proper arrangement of eight 6-inch-diameter dial gauges, is to be installed, six gauges to be placed on the board under this contract, with space at bottom of board for two additional gauges. Gauges to register pressure in cold water, hot water, steam, and compressed air, and the vacuum in the vacuum and vacuum cleaning system mains.

348. The board is to be set out from wall to allow access to all connections to gauges which are to be made at back of board, and

the board is to be supported by cast or wrought iron brackets bolted to board, with bolts having brass hexagonal acorn cap nuts, and be secured to wall with expansion bolts.

349. Gauges are to be of first-class and approved manufacture, having noncorrosive movements and brass cases and ring, all arranged for back conections with stopcocks and also drips on water and steam connections. A siphon is to be provided on steam connection.

350. The maximum readings for the dials of the six gauges are to be, approximately, for cold-water gauge 200 pounds, for steam and hot-water gauges 100 pounds, for compressed-air gauge 60 pounds, and for the two vacuum gauges, 30 inches.

351. Connections from mains to be $\frac{1}{2}$-inch-diameter galvanized-iron pipe, reduced at gauges to $\frac{1}{4}$ inch diameter.

352. All connections, gauges, nuts, etc., on front of board are to be of brass, highly polished and lacquered.

353. In addition to the gauges on gauge board, gauges with iron bodies and brass rings with 4-inch-diameter dials, to register maximum pressure of 100 pounds, are to be provided and connected to each branch from the water main in subbasement, just beyond each pressure regulating valve, being fastened to adjacent wall, in an approved manner, where directed by the mechanical engineers. Stopcocks and drips are to be provided at gauges and connections from the mains to be $\frac{1}{2}$ inch diameter and run as directed.

Tests.

354. All piping installed under this section of the specification, except cold-water mains in subbasement, gas and air piping, to be subjected to a hydrostatic-pressure test of 80 pounds per square inch, cold-water mains in subbasement to a hydrostatic-pressure test of 150 pounds per square inch, piping of cleaning and vacuum systems to an air-pressure test of 40 pounds per square inch, and compressed-air piping to an air-pressure test of 80 pounds per square inch.

355. All piping must be made absolutely tight under the pressure at which it is tested.

356. Tests may be made in sections, as directed by the mechanical engineers, and all appliances, including pumps, gauges, temporary connections, etc., necessary for the tests must be furnished by the contractor.

Cleaning.

357. All pipes must be thoroughly cleaned of all iron cuttings, etc., from reaming, tapping, etc., and should any pipe be stopped up by such refuse, after the apparatus has been accepted, the contractor will be held responsible for all damages caused by neglect to comply with this provision.

Coverings.

358. After the piping has been entirely completed, subjected to the required tests, and approved by the mechanical engineers, all the exposed steam, steam drip, cold water, hot water, hot-water circulation, drinking water and drinking-water circulation piping in the entire subbasement, and all the steam, steam drip, cold water, hot water and hot-water circulation piping in pipe shafts and in stories above the subbasement, are to be covered with nonconducting sectional and removable coverings, not less than 1 inch thick. Coverings for valves and fittings may be molded of asbestos or magnesia cement and all coverings must be provided with a heavy canvas jacket.

359. All coverings must be secured in place and comply with the specification for materials of coverings as stated in Section III of this specification.

360. Special attention must be given to fitting coverings neatly around outlets and at location of pipe supports.

Painting.

361. All pipes, hangers, and all other ironwork to be painted all over with one coat of best quality red lead and linseed oil, and all work not to be covered to be given two additional coats having tints as approved, to match adjacent finish.

362. All canvas-jacketed pipe coverings are to be painted with two coats of best quality asbestos paint, the finishing tints to be selected by the mechanical engineers. Brass bands are to be removed while coverings are being painted and replaced after paint is dry.

PROPOSAL FOR HEATING AND VENTILATION AND SPECIAL PIPING SYSTEMS OF TWO LABORATORY BUILDINGS FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

N. B.

363. After these proposal sheets have been filled out by the bidder, they must be detached from specification and forwarded under separate cover, with postage prepaid by the sender.

364. Bidders are notified that lump-sum proposals for the entire work must be submitted and that proposals for only portions of the work will not receive consideration. All amounts of proposals must include work in both buildings.

365. The various amounts, names of appliances, materials, etc., on the proposal sheet are requested to be typewritten.

....., 190 .

To the SECRETARY OF AGRICULTURE,
Washington, D. C.

SIR: .

366. ..... hereby propose to furnish all the labor and materials to complete the entire Heating and Ventilation and Special Piping Systems of Two Laboratory Buildings for the United States Department of Agriculture, in strict accordance with drawings Nos. H–V–1 to H–V–15, inclusive, and Nos. S–P–51 to S–P–58, inclusive,

and the specification, for the sum of .....

.....

..... ($.....)

367. Amount included in total bid for all labor and materials required in connection with the Heating and Ventilation System,

specified under Section III of the specification, ...

.....

..... ($.....)

368. Amount included in total bid for all labor and materials required in connection with the Special Piping System, specified under Section IV of the specification, ...

.....

..... ($.....)

369. Amount to be deducted from total bid if the entire air-washing apparatus, specified in connection with Heating and Ventilation System, is omitted, ...

.....

..... ($.....)

370. Amount for which an alternate air-washing apparatus, specified by paragraph 65, will be installed complete, ...

.....

..... ($.....)

371. Amount included in total bid for the temperature control apparatus complete, ...

.....

..... ($.....)

372. Amount included in total bid for all pipe coverings specified under Section III of the specification, ...

.....

..... ($.....)

373. Amount included in total bid for all pipe coverings specified under Section IV of the specification, ...

.....

..... ($.....)

374. Amount included in total bid for each drinking fountain specified under Section IV of the specification, not including placing, trimmings, and supports, ...

.....

..... ($.....)

375. Amount included in total bid for each gauge board complete with gauges, connections, etc., ...

.....

..... ($.....)

376. Amount included in total bid for all work and materials required in connection with the vacuum cleaning system, ...

.....

..... ($.....)

377. Amount to be added to total bid if brass tin-lined pipe is used in lieu of galvanized-iron tin-lined pipe for distilled-water piping,

.....

..... ($.....)

378. Bidders must fill out the following blanks, giving name and address of manufacturer, and where appliances are not special the trade name or catalogue number of the appliances, materials, etc., proposed to be used, with the understanding that the articles named must be in accordance with the specification requirements relative thereto and subject to the approval of the mechanical engineers:

Direct radiators, ...

Indirect radiators, ...

Expansion joints, ...

Pipe hangers, ...

Thermometers, ...

Pressure regulating valves, ...

Gate valves, ...

Globe valves, ...

Radiator valves, ...

Air valves, ...

Gauges, ...

Pipe coverings, ...

Drinking fountains, ...

Drinking-fountain faucets, ...

Registers, ...

Combination starting and regulating rheostats, ...

.....

Automatic starting rheostat, ...

Switches for motor tablet boards, ...

System of temperature control, ...

.....

Pump Data (379) :

Make, ...

Size, ...

Speed, ...

Fan Data (380) :

Centrifugal Fans—

Make, ... Revolutions per minute, ...

Diameter of wheel, ... Width of wheel, ...

Diameter of inlets, ... Diameter of outlets, ...

Disk Fans—

Make, ...

Guaranteed capacity under free discharge, ...

60-inch-diam. fan at 320 r. p. m. ..... c. f. p. m.

54-inch-diam. fan at 290 r. p. m. ..... c. f. p. m.

48-inch-diam. fan at 330 r. p. m. ..... c. f. p. m.

Motor Data (381) :

Pump Motors—

Guaranteed horsepower at full load, ...

Efficiency at full load, ... per cent; at $\frac{3}{4}$ load, ... per cent

Efficiency at $\frac{1}{2}$ load, ... per cent; at $\frac{1}{4}$ load, ... per cent.

Centrifugal Fan Motors—

Guaranteed horsepower at full load, ...

Efficiency at full load, ... per cent; at $\frac{3}{4}$ load, ... per cent.

Efficiency at $\frac{1}{2}$ load, ... per cent; at $\frac{1}{4}$ load, ... per cent.

60-inch Disk Fan Motors—

Guaranteed horsepower at full load, ...

Efficiency at full load, ... per cent; at $\frac{3}{4}$ load, ... per cent.

Efficiency at $\frac{1}{2}$ load, ... per cent; at $\frac{1}{4}$ load, ... per cent.

54-inch Disk Fan Motors—

Guaranteed horsepower at full load, ...

Efficiency at full load, ... per cent; at $\frac{3}{4}$ load, ... per cent.

Efficiency at $\frac{1}{2}$ load, ... per cent; at $\frac{1}{4}$ load, ... per cent.

VI

48-inch Disk Fan Motors—

Guaranteed horsepower at full load, ...

Efficiency at full load, ... per cent; at $\frac{3}{4}$ load, ... per cent.

Efficiency at $\frac{1}{2}$ load, ... per cent; at $\frac{1}{4}$ load, ... per cent.

(Signature) .....

(Address) .....

NAMES OF INDIVIDUAL MEMBERS OF FIRM.

....

.....

NAME OF CORPORATION. NAME OF SECRETARY.

....

NAME OF PRESIDENT. UNDER WHAT LAW CORPORATION IS ORGANIZED.

....